

We Claim:

1. A high early-strength reinforced pre-cast or cast in place cementitious member comprising a cementitious composition containing:

- (a) hydraulic cement;
- (b) polycarboxylate dispersant; and
- (c) structural synthetic fibers;

wherein without metal bar, metal fiber or metal rod reinforcement the cementitious member develops a high early-strength of at least about 1,400 pounds per square inch (psi) flexural strength and at least about 7,500 pounds per square inch (psi) compressive strength within about 24 hours after placing the cementitious composition, unset but hydrated, in a mold.

2. The cementitious member of claim 1 wherein the member is prepared by mixing water and hydraulic cement, polycarboxylate dispersant, and structural synthetic fibers, wherein the water to cement ratio is about 0.2 to about 0.35.

3. The cementitious member of claim 1 wherein the cementitious materials content is about 800 lb/yd³ to about 1,600 lb/yd³.

4. The cementitious member of claim 1 wherein the structural synthetic fibers are at least one of structural plastic fibers, carbon, glass, or mixtures thereof.

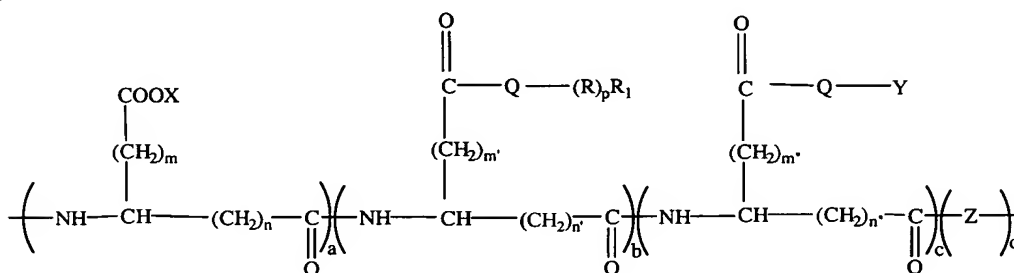
5. The cementitious member of claim 4 wherein the structural plastic fibers are at least one of polyethylene, polyester, rayon, or mixtures thereof.

6. The cementitious member of claim 1 wherein the structural synthetic fibers have a diameter of about 0.6 millimeters to about 1.2 millimeters.

7. The cementitious member of claim 1 wherein the structural synthetic fibers have a diameter of about 0.8 millimeters to about 1.0 millimeters.

8. The cementitious member of claim 1 wherein the structural synthetic fibers have a length of about 15 millimeters to about 75 millimeters.
9. The cementitious member of claim 1 wherein the structural synthetic fibers have a modulus of about 3,000 N/mm² to about 4,000 N/mm².
10. The cementitious member of claim 1 wherein the structural synthetic fibers have a modulus of about 3,250 N/mm² to about 3,750 N/mm².
11. The cementitious member of claim 1 wherein the polycarboxylate dispersant is at least one of formulas a) through j):

a) a dispersant of Formula (I):



wherein in Formula (I)

X is at least one of hydrogen, an alkali earth metal ion, an alkaline earth metal ion, ammonium ion, or amine;

R is at least one of C₁ to C₆ alkyl(ene) ether or mixtures thereof or C₁ to C₆ alkyl(ene) imine or mixtures thereof;

Q is at least one of oxygen, NH, or sulfur;

p is a number from 1 to about 300 resulting in at least one of a linear side chain or branched side chain;

R₁ is at least one of hydrogen, C₁ to C₂₀ hydrocarbon, or functionalized hydrocarbon containing at least one of -OH, -COOH, an ester or amide derivative of -COOH, sulfonic acid, an ester or amide derivative of sulfonic acid, amine, or epoxy;

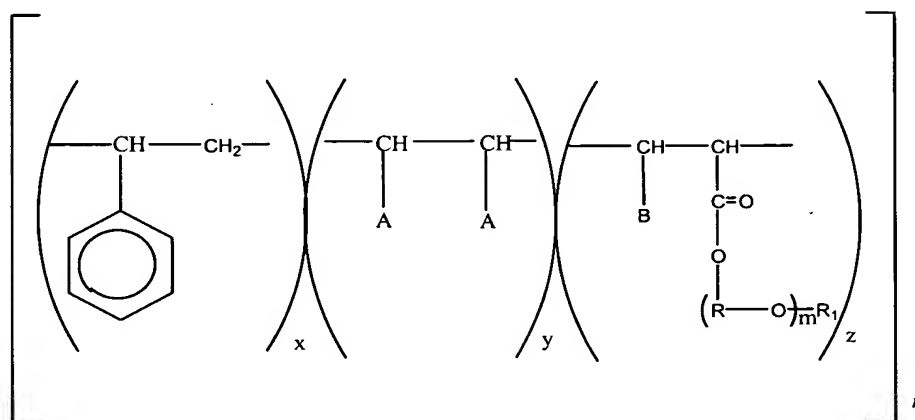
Y is at least one of hydrogen, an alkali earth metal ion, an alkaline earth metal ion, ammonium ion, amine, a hydrophobic hydrocarbon or polyalkylene oxide moiety that functions as a defoamer;

m, m', m'', n, n', and n'' are each independently 0 or an integer between 1 and about 20;

Z is a moiety containing at least one of i) at least one amine and one acid group, ii) two functional groups capable of incorporating into the backbone selected from the group consisting of dianhydrides, dialdehydes, and di-acid-chlorides, or iii) an imide residue; and

wherein a, b, c, and d reflect the mole fraction of each unit wherein the sum of a, b, c, and d equal one, wherein a, b, c, and d are each a value greater than or equal to zero and less than one, and at least two of a, b, c, and d are greater than zero;

b) a dispersant of Formula (II):



wherein in Formula (II):

A is COOM or optionally in the "y" structure an acid anhydride group (-CO-O-CO-) is formed in place of the A groups between the carbon atoms to which the A groups are bonded to form an anhydride;

B is COOM

M is hydrogen, a transition metal cation, the residue of a hydrophobic polyalkylene glycol or polysiloxane, an alkali metal ion, an alkaline earth metal ion, ferrous ion, aluminum ion, (alkanol)ammonium ion, or (alkyl)ammonium ion;

R is a C₂₋₆ alkylene radical;

R₁ is a C₁₋₂₀ alkyl, C₆₋₉ cycloalkyl, or phenyl group;

x, y, and z are a number from 0.01 to 100;

m is a number from 1 to 100; and

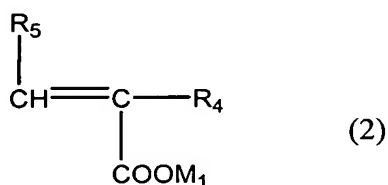
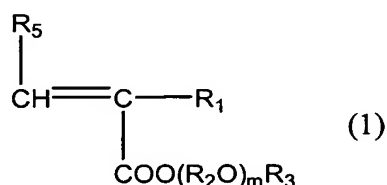
n is a number from 10 to 100;

c) a dispersant comprising at least one polymer or a salt thereof having the form of a copolymer of

i) a maleic anhydride half-ester with a compound of the formula RO(AO)_mH, wherein R is a C₁₋₂₀ alkyl group, A is a C₂₋₄ alkylene group, and m is an integer from 2-16; and

ii) a monomer having the formula CH₂=CHCH₂-(OA)_nOR, wherein n is an integer from 1-90 and R is a C₁₋₂₀ alkyl group;

d) a dispersant obtained by copolymerizing 5 to 98% by weight of an (alkoxy)polyalkylene glycol mono(meth)acrylic ester monomer (a) represented by the following general formula (1):

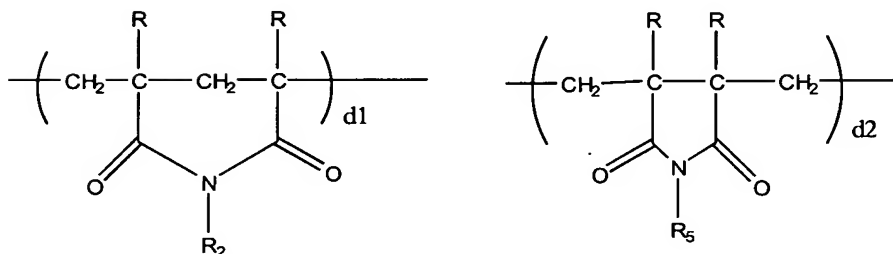
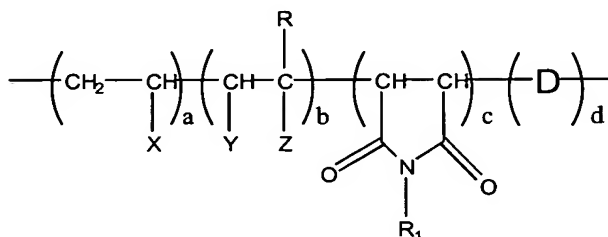


wherein R₁ stands for hydrogen atom or a methyl group, R₂O for one species or a mixture of two or more species of oxyalkylene group of 2 to 4 carbon atoms, providing two or more species of the mixture may be added either in the form of a block or in a random form, R₃ for a hydrogen atom or an alkyl group of 1 to 5 carbon atoms, and m is a value indicating the average addition mol number of oxyalkylene groups that is an integer in the range of 1 to 100, 95 to 2% by weight of a (meth)acrylic acid monomer (b) represented by the above general formula (2), wherein R₄ and R₅ are each independently a hydrogen atom or a methyl group, and M₁ for a hydrogen

atom, a monovalent metal atom, a divalent metal atom, an ammonium group, or an organic amine group, and 0 to 50% by weight of other monomer (c) copolymerizable with these monomers, provided that the total amount of (a), (b), and (c) is 100% by weight;

- 5 e) a graft polymer that is a polycarboxylic acid or a salt thereof, having side chains derived from at least one species selected from the group consisting of oligoalkyleneglycols, polyalcohols, polyoxyalkylene amines, and polyalkylene glycols;
- f) a dispersant of Formula (III):

10



wherein in Formula (III):

D = a component selected from the group consisting of the structure d1, the structure d2, and mixtures thereof;

X = H, CH₃, C₂ to C₆ Alkyl, Phenyl, p-Methyl Phenyl, or Sulfonated Phenyl;

Y = H or -COOM;

R = H or CH₃;

Z = H, -SO₃M, -PO₃M, -COOM, -O(CH₂)_nOR₃ where n = 2 to 6, -COOR₃, or -(CH₂)_nOR₃ where n = 0 to 6, -CONHR₃, -CONHC(CH₃)₂CH₂SO₃M, -COO(CHR₄)_nOH where n = 2 to 6, or -O(CH₂)_nOR₄ wherein n = 2 to 6;

R_1, R_2, R_3, R_5 are each independently $-(\text{CHRCH}_2\text{O})_m\text{R}_4$ random copolymer of oxyethylene units and oxypropylene units where $m = 10$ to 500 and wherein the amount of oxyethylene in the random copolymer is from about 60% to 100% and the amount of oxypropylene in the random copolymer is from 0% to about 40%;

$R_4 = \text{H, Methyl, C}_2 \text{ to about C}_6 \text{ Alkyl, or about C}_6 \text{ to about C}_{10} \text{ aryl};$

$M = \text{H, Alkali Metal, Alkaline Earth Metal, Ammonium, Amine, triethanol amine, Methyl, or C}_2 \text{ to about C}_6 \text{ Alkyl};$

$a = 0 \text{ to about } 0.8;$

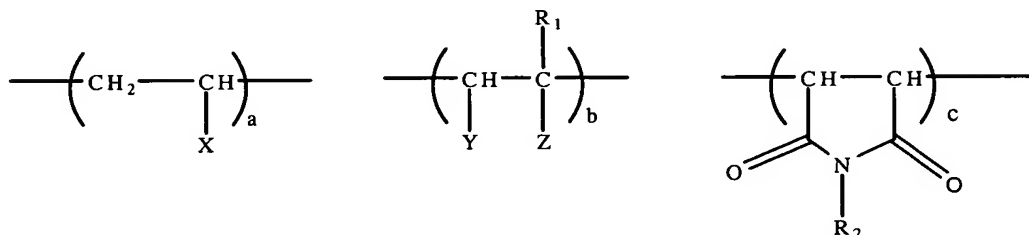
$b = \text{about } 0.2 \text{ to about } 1.0;$

$c = 0 \text{ to about } 0.5;$

$d = 0 \text{ to about } 0.5; \text{ and}$

wherein $a, b, c,$ and d represent the mole fraction of each unit and the sum of $a, b, c,$ and d is 1.0;

g) a dispersant of Formula (IV):



wherein in Formula (IV):

the “b” structure is one of a carboxylic acid monomer, an ethylenically unsaturated monomer, or maleic anhydride wherein an acid anhydride group ($-\text{CO}-\text{O}-\text{CO}-$) is formed in place of the groups Y and Z between the carbon atoms to which the groups Y and Z are bonded respectively, and the “b” structure must include at least one moiety with a pendant ester linkage and at least one moiety with a pendant amide linkage;

$X = \text{H, CH}_3, \text{C}_2 \text{ to C}_6 \text{ Alkyl, Phenyl, p-Methyl Phenyl, p-Ethyl Phenyl, Carboxylated Phenyl, or Sulfonated Phenyl};$

$Y = \text{H, } -\text{COOM, } -\text{COOH, or W};$

W = a hydrophobic defoamer represented by the formula $R_sO-(CH_2CH_2O)_s-(CH_2C(CH_3)HO)_t-(CH_2CH_2O)_u$ where s, t, and u are integers from 0 to 200 with the proviso that $t > (s+u)$ and wherein the total amount of hydrophobic defoamer is present in an amount less than about 10% by weight of the polycarboxylate dispersant;

Z = H, -COOM, $-O(CH_2)_nOR_3$ where n = 2 to 6, $-COOR_3$, $-(CH_2)_nOR_3$ where n = 0 to 6, or $-CONHR_3$;

R_1 = H, or CH_3 ;

R_2, R_3 , are each independently a random copolymer of oxyethylene units and oxypropylene units of the general formula $-(CH(R_1)CH_2O)_mR_4$ where m = 10 to 500 and wherein the amount of oxyethylene in the random copolymer is from about 60% to 100% and the amount of oxypropylene in the random copolymer is from 0% to about 40%;

R_4 = H, Methyl, or C_2 to C_8 Alkyl;

R_5 = C_1 to C_{18} alkyl or C_6 to C_{18} alkyl aryl;

M = Alkali Metal, Alkaline Earth Metal, Ammonia, Amine, monoethanol amine, diethanol amine, triethanol amine, morpholine, imidazole;

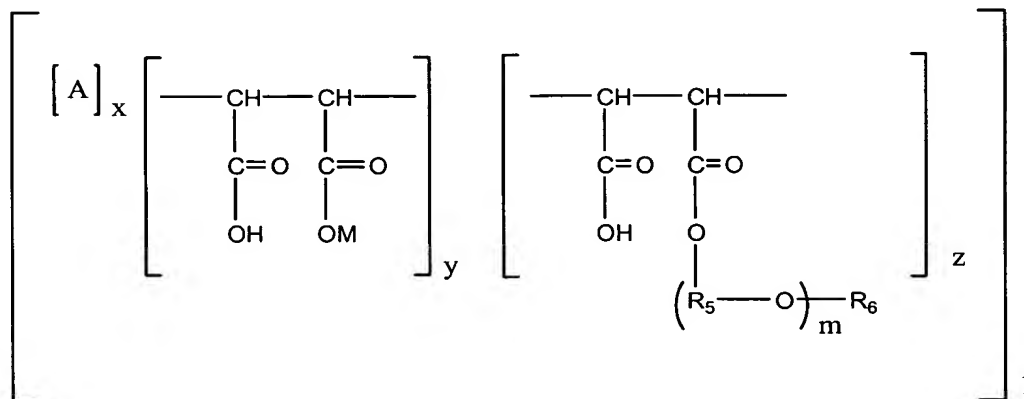
a = 0.01-0.8;

b = 0.2-0.99;

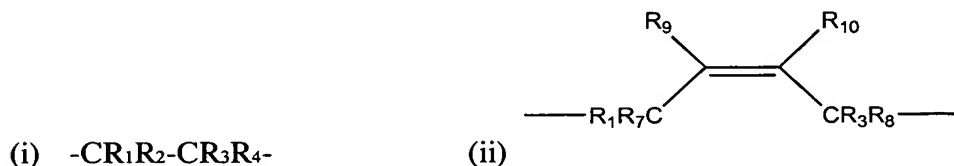
c = 0-0.5; and

wherein a, b, c represent the mole fraction of each unit and the sum of a, b, and c, is 1;

- h) a random copolymer corresponding to the following Formula (V) in free acid or salt form having the following monomer units and numbers of monomer units:



5 wherein A is selected from the moieties (i) or (ii)



wherein R_1 and R_3 are selected from substituted benzene, C_{1-8} alkyl, C_{2-8} alkenyl, C_{2-8} alkylcarbonyl, C_{1-8} alkoxy, carboxyl, hydrogen, and a ring, R_2 and R_4 are selected from the group consisting of hydrogen and C_{1-4} alkyl, wherein R_1 and R_3 can together with R_2 and/or R_4 when R_2 and/or R_4 are C_{1-4} alkyl form the ring; ;

R_7 , R_8 , R_9 , and R_{10} are individually selected from the group consisting of hydrogen, C_{1-6} alkyl, and a C_{2-8} hydrocarbon chain, wherein R_1 and R_3 together with R_7 and/or R_8 , R_9 , and R_{10} form the C_{2-8} hydrocarbon chain joining the carbon atoms to which they are attached, the hydrocarbon chain optionally having at least one anionic group, wherein the at least one anionic group is optionally sulfonic;

M is selected from the group consisting of hydrogen, and the residue of a hydrophobic polyalkylene glycol or a polysiloxane, with the proviso that when A is (ii) and M is the residue of a hydrophobic polyalkylene glycol, M must be different from the group $\text{---}(\text{R}_5\text{O})_m\text{R}_6\text{---}$;

R_5 is a C_{2-8} alkylene radical;

R_6 is selected from the group consisting of C_{1-20} alkyl, C_{6-9} cycloalkyl and phenyl;

n , x , and z are numbers from 1 to 100;

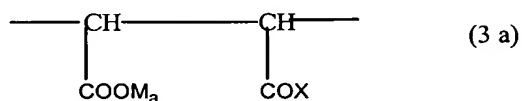
5 y is 0 to 100;

m is 2 to 1000;

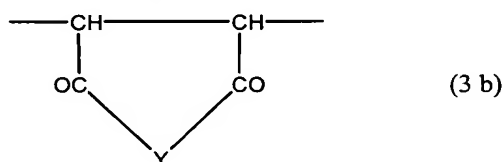
the ratio of x to $(y+z)$ is from 1:10 to 10:1 and the ratio of $y:z$ is from 5:1 to 1:100;

10 i) a copolymer of oxyalkyleneglycol-alkenyl ethers and unsaturated dicarboxylic acids, comprising:

i) 0 to 90 mol % of at least one component of the formula 3a or 3b:



or



15 wherein M is a hydrogen atom, a mono- or divalent metal cation, an ammonium ion or an organic amine residue, a is 1, or when M is a divalent metal cation a is $\frac{1}{2}$;

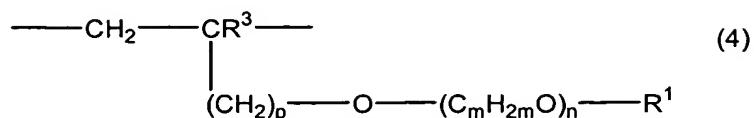
wherein X is $-\text{OM}_a$,

20 $-\text{O}-(\text{C}_m\text{H}_{2m}\text{O})_n-\text{R}^1$ in which R^1 is a hydrogen atom, an aliphatic hydrocarbon radical containing from 1 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an optionally hydroxyl, carboxyl, C_{1-14} alkyl, or sulphonic substituted aryl radical containing 6 to 14 carbon atoms, m is 2 to 4, and n is 0 to 100,

$-\text{NHR}_2$, $-\text{N}(\text{R}^2)_2$ or mixtures thereof in which $\text{R}^2 = \text{R}^1$ or $-\text{CO}-\text{NH}_2$; and

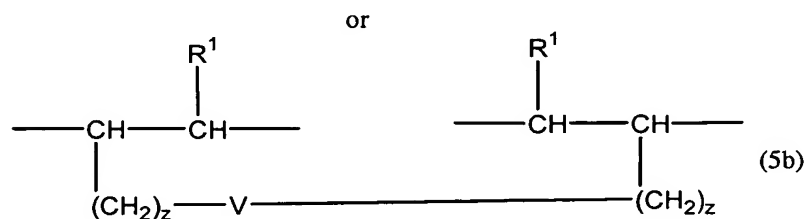
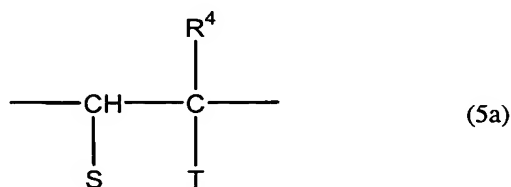
25 wherein Y is an oxygen atom or $-\text{NR}^2$;

ii) 1 to 89 mol% of components of the general formula 4:

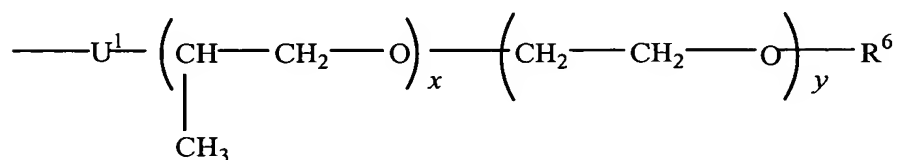


wherein R_3 is a hydrogen atom or an aliphatic hydrocarbon radical containing from 1 to 5 carbon atoms, p is 0 to 3, and R_1 is hydrogen, an aliphatic hydrocarbon radical containing from 1 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an optionally hydroxyl, carboxyl, C_{1-14} alkyl, or sulfonic substituted aryl radical containing 6 to 14 carbon atoms, m is 2 to 4, and n is 0 to 100, and

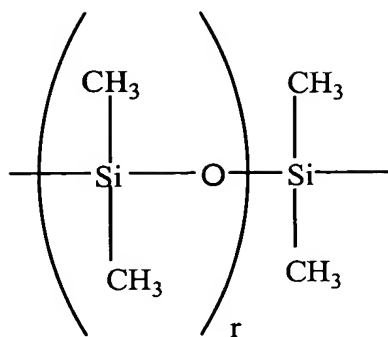
iii) 0.1 to 10 mol % of at least one component of the formula 5a or 5b:



wherein S is a hydrogen atom or $-\text{COOM}_a$ or $-\text{COOR}_5$, T is $-\text{COOR}_5$, $-\text{W-R}_7$, $-\text{CO}-[\text{NH}-(\text{CH}_2)_3]_s\text{W-R}_7$, $-\text{CO-O}-(\text{CH}_2)_z\text{W-R}_7$, a radical of the general formula:

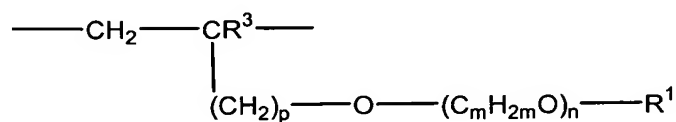


or $-(\text{CH}_2)_z\text{V}-(\text{CH}_2)_z\text{CH}=\text{CH-R}_1$, or when S is $-\text{COOR}_5$ or $-\text{COOM}_a$, U_1 is $-\text{CO-NHM-}$, $-\text{O-}$ or $-\text{CH}_2\text{O}$, U_2 is $-\text{NH-CO-}$, $-\text{O-}$ or $-\text{OCH}_2$, V is $-\text{O-CO-C}_6\text{H}_4\text{-CO-O-}$ or $-\text{W-}$, and W is

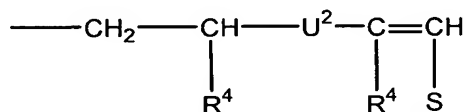
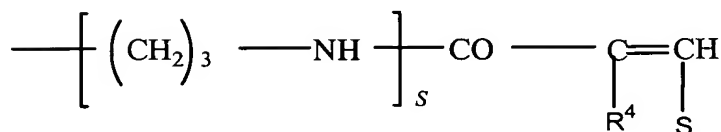


R4 is a hydrogen atom or a methyl radical, R5 is an aliphatic hydrocarbon radical containing 3 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an aryl radical containing 6 to 14 carbon atoms, R₆=R₁ or

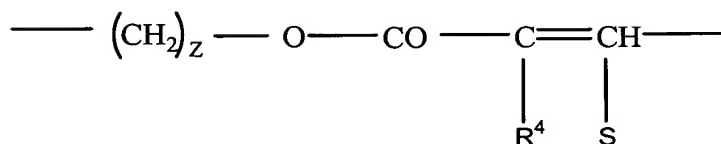
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or

R₇=R₁ or

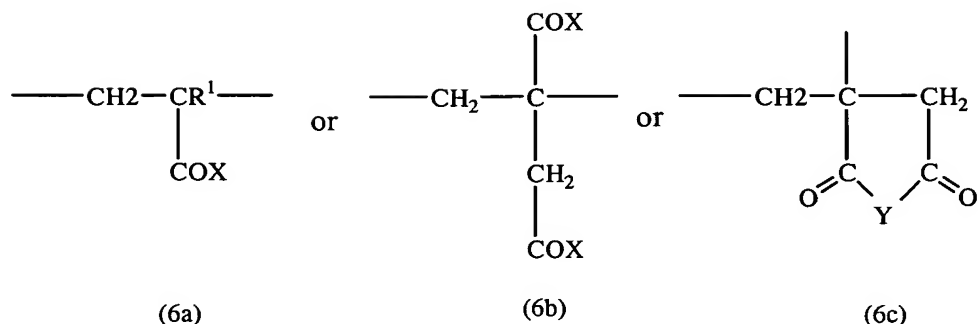
or



r is 2 to 100, s is 1 or 2, x is 1 to 150, y is 0 to 15 and z is 0 to 4;

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iv) 0 to 90 mol % of at least one component of the formula 6a, 6b, or 6c:



wherein M is a hydrogen atom, a mono- or divalent metal cation, an ammonium ion or an organic amine residue, a is 1, or when M is a divalent metal cation a is $\frac{1}{2}$;

wherein X is ---OM_a ,

$\text{---O---(C}_m\text{H}_{2m}\text{O)}_n\text{---R}^1$ in which R^1 is a hydrogen atom, an aliphatic hydrocarbon radical containing from 1 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an optionally hydroxyl, carboxyl, C_{1-14} alkyl, or sulphonic substituted aryl radical containing 6 to 14 carbon atoms, m is 2 to 4, and n is 0 to 100,

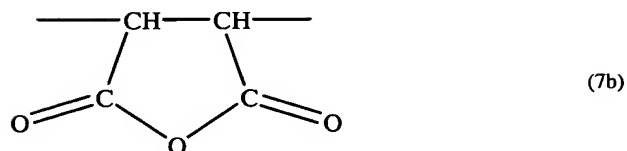
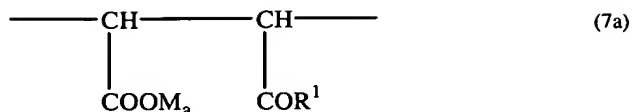
$\text{---NH---(C}_m\text{H}_{2m}\text{O)}_n\text{---R}^1$,

---NHR_2 , $\text{---N(R}^2\text{)}_2$ or mixtures thereof in which $\text{R}^2 = \text{R}^1$ or ---CO---NH_2 ; and

wherein Y is an oxygen atom or ---NR^2 ;

j) a copolymer of dicarboxylic acid derivatives and oxyalkylene glycol-alkenyl ethers, comprising:

i) 1 to 90 mol.% of at least one member selected from the group consisting of structural units of formula 7a and formula 7b:



wherein M is H, a monovalent metal cation, a divalent metal cation, an ammonium ion or an organic amine;

a is $\frac{1}{2}$ when M is a divalent metal cation or 1 when M is a monovalent metal cation;

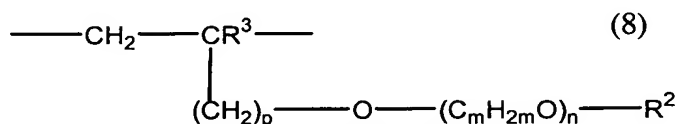
wherein R^1 is $-\text{OM}_a$, or

$-\text{O}-(\text{C}_m\text{H}_{2m}\text{O})_n-\text{R}^2$ wherein R^2 is H, a C_{1-20} aliphatic hydrocarbon, a C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one member selected from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}]$;

m is 2 to 4;

n is 1 to 200;

ii) 0.5 to 80 mol. % of the structural units of formula 8:



wherein R^3 is H or a C_{1-5} aliphatic hydrocarbon;

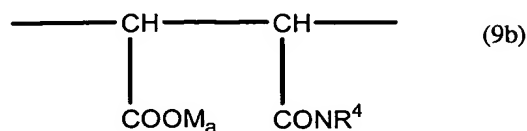
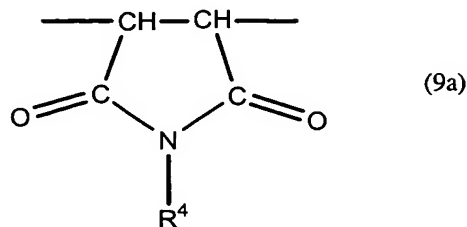
p is 0 to 3;

R^2 is H, a C_{1-20} aliphatic hydrocarbon, a C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one member selected from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}]$;

m is 2 to 4;

n is 1 to 200;

iii) 0.5 to 80 mol. % structural units selected from the group consisting of formula 9a and formula 9b:



wherein R^4 is H, C_{1-20} aliphatic hydrocarbon that is optionally substituted with at least one hydroxyl group, $-(\text{C}_m\text{H}_{2m}\text{O})_n\text{-R}^2$, $-\text{CO-NH-R}^2$, C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one member selected from the group consisting of $[-\text{COOM}_a]$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}$;

M is H, a monovalent metal cation, a divalent metal cation, an ammonium ion or an organic amine;

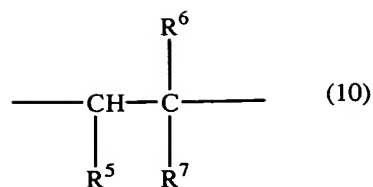
a is $\frac{1}{2}$ when M is a divalent metal cation or 1 when M is a monovalent metal cation;

R^2 is H, a C_{1-20} aliphatic hydrocarbon, a C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one member selected from the group consisting of $[-\text{COOM}_a]$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}$;

m is 2 to 4;

n is 1 to 200;

iv) 1 to 90 mol. % of structural units of formula 10



wherein R⁵ is methyl, or methylene group, wherein R⁵ forms one or more 5 to 8 membered rings with R⁷;

R⁶ is H, methyl, or ethyl;

- 5 R⁷ is H, a C₁₋₂₀ aliphatic hydrocarbon, a C₆₋₁₄ aryl that is optionally substituted with at least one member selected from the group consisting of [-COOM_a, -(SO₃)M_a, and -(PO₃)M_{a2}], a C₅₋₈ cycloaliphatic hydrocarbon, -OCOR⁴, -OR⁴, or -COOR⁴, wherein R⁴ is H, a C₁₋₂₀ aliphatic hydrocarbon that is optionally substituted with at least one -OH, -(C_mH_{2m}O)_n-R², -CO-NH-R²,
 10 C₅₋₈ cycloaliphatic hydrocarbon, or a C₆₋₁₄ aryl residue that is optionally substituted with a member selected from the group consisting of [-COOM_a, -(SO₃)M_a, -(PO₃)M_{a2}].

12. The cementitious member of claim 11 wherein the member is prepared by mixing
 15 water and hydraulic cement, polycarboxylate dispersant, and structural synthetic fibers, wherein the water to cement ratio is about 0.2 to about 0.35.
13. The cementitious member of claim 11 wherein the cementitious materials content is about 800 lb/yd³ to about 1,600 lb/yd³.
- 20 14. The cementitious member of claim 11 wherein the structural synthetic fibers are at least one of structural plastic fibers, carbon, glass, or mixtures thereof.
15. The cementitious member of claim 14 wherein the structural plastic fibers are at
 25 least one of polyethylene, polyester, rayon, or mixtures thereof.
16. The cementitious member of claim 11 wherein the structural synthetic fibers have a diameter of about 0.6 millimeters to about 1.2 millimeters.

17. The cementitious member of claim 11 wherein the structural synthetic fibers have a diameter of about 0.8 millimeters to about 1.0 millimeters.
18. The cementitious member of claim 11 wherein the structural synthetic fibers have a length of about 15 millimeters to about 75 millimeters.
19. The cementitious member of claim 11 wherein the structural synthetic fibers have a modulus of about 3,000 N/mm² to about 4,000 N/mm².
20. The cementitious member of claim 11 wherein the structural synthetic fibers have a modulus of about 3,250 N/mm² to about 3,750 N/mm².
21. The cementitious member of claim 1 or 11, wherein the polycarboxylate high range water reducing dispersant has a solids content of about 20% to about 30% and is present in an amount from about 5 to about 35 oz/cwt.
22. The cementitious member of claim 1 or 11, wherein the primary active ingredient of the polycarboxylate high range water reducing dispersant is about 0.025% to about 0.7% based on the dry weight of cement.
23. The cementitious member of claim 1 or 11 wherein the structural synthetic fiber loadings are about 1% to about 10% by volume of the composition.
24. The cementitious member of claim 1 or 11 wherein a set accelerator is present.
25. The cementitious member of claim 24 wherein the set accelerator comprises at least one of:
 - a) a nitric acid salt of an alkali metal, alkaline earth metal, or aluminum;
 - b) a nitrite salt of an alkali metal, alkaline earth metal, or aluminum;
 - c) a thiocyanic acid salt of an alkali metal, alkaline earth metal or aluminum;
 - d) an alkanolamine;
 - e) a thiosulfate of an alkali metal, alkaline earth metal, or aluminum;

- f) a carboxylic acid salt of an alkali metal, alkaline earth metal, or aluminum;
or
- g) a polyhydroxylalkylamine.

- 5 26. The cementitious member of claim 1 or 11 wherein a set retarder is present.
27. The cementitious member of claim 26 wherein the set retarder is at least one of an
oxy-boron compound, lignin, a polyphosphonic acid, a carboxylic acid, a
hydroxycarboxylic acid, polycarboxylic acid, hydroxylated carboxylic acid,
10 fumaric, itaconic, malonic, borax, gluconic, and tartaric acid, lignosulfonates,
ascorbic acid, isoascorbic acid, sulphonic acid-acrylic acid copolymer, and their
corresponding salts, polyhydroxysilane, polyacrylamide, carbohydrates or mixtures
thereof.
- 15 28. The cementitious member of claim 1 or 11 wherein the hydraulic cement is at least
one of portland cement, modified portland cement, masonry cement, or mixtures
thereof.
29. The cementitious member of claim 1 or 11 further including pozzolan that is at least
20 one of diatomaceous earth, opaline cherts, clays, shales, fly ash, silica fume,
volcanic tuffs and pumicites, metakaolin, granulated blast furnace slag, fly ash, or
mixtures thereof.
30. The cementitious member of claim 1 or 11 further comprising a cement admixture
25 or additive that is at least one of air detrainning agents, water reducers, wetting
agents, water soluble polymers, strength enhancing agents, rheology modifying
agents, water repellents, dampproofing admixtures, gas formers, permeability
reducers, pumping aids, fungicidal admixtures, germicidal admixtures, insecticidal
admixtures, finely divided mineral admixtures, alkali-reactivity reducer, bonding
30 admixtures, shrinkage compensation agents, defoamers or aggregate.
31. The cementitious member of claim 30 wherein the shrinkage compensation agent is
at least one of $\text{RO(AO)}_{1-10}\text{H}$, wherein R is a C_{1-5} alkyl or C_{5-6} cycloalkyl radical and

A is a C₂₋₃ alkylene radical, alkali metal sulfates, alkaline earth metal sulfates, or alkaline earth oxides.

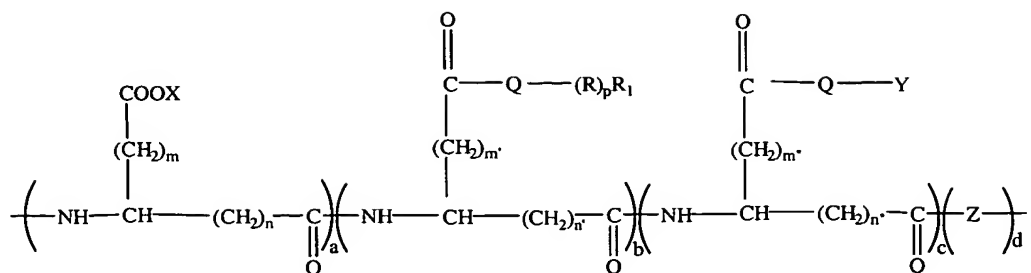
32. The cementitious member of claim 31 wherein the alkaline earth oxides are at least one of sodium sulfate or calcium oxide.
33. The cementitious member of claim 30 wherein the defoamer is at least one of silicones or petroleum oil mixtures.
34. The cementitious member of claim 1 or 11 wherein the member is at least one of wall panels, beams or columns.
35. A method of making a high early-strength reinforced pre-cast or cast in place member comprising:
 - a. preparing a high early-strength reinforced cementitious composition by mixing water and strength generating ingredients comprising, hydraulic cement, polycarboxylate dispersant, and structural synthetic fibers; and
 - b. forming a cementitious member without metal bar, metal fiber or metal rod reinforcement from the high early-strength reinforced cementitious composition wherein the cementitious member develops a high early-strength of at least about 1,400 pounds per square inch (psi) flexural strength and at least about 7,500 pounds per square inch (psi) compressive strength within about 24 hours after placing the cementitious composition in a mold.
36. The method of claim 35, wherein said forming is one of i) placing said unset high early-strength reinforced cementitious composition in a mold and vibrating said mold, ii) allowing the high early-strength reinforced cementitious composition to cure or set into an article, and iii) stripping the cured or set article from said mold.
37. The method of claim 35 wherein a set accelerator is present.

38. The method of claim 37, wherein the set accelerator comprises at least one of:
- a) a nitrate salt of an alkali metal, alkaline earth metal, or aluminum;
 - b) a nitrite salt of an alkali metal, alkaline earth metal, or aluminum;
 - c) a thiocyanate of an alkali metal, alkaline earth metal or aluminum;
 - 5 d) an alkanolamine;
 - e) a thiosulfate of an alkali metal, alkaline earth metal, or aluminum;
 - f) a carboxylic acid salt of an alkali metal, alkaline earth metal, or aluminum;
 - or
 - g) a polyhydroxylalkylamine.
- 10 39. The method of claim 35 wherein a set retarder is present.
40. The method of claim 39 wherein the set retarder is at least one of an oxy-boron compound, lignin, a polyphosphonic acid, a carboxylic acid, a hydroxycarboxylic acid, polycarboxylic acid, hydroxylated carboxylic acid, fumaric, itaconic, malonic, 15 borax, gluconic, and tartaric acid, lignosulfonates, ascorbic acid, isoascorbic acid, sulphonic acid-acrylic acid copolymer, and their corresponding salts, polyhydroxysilane, polyacrylamide, carbohydrates or mixtures thereof.
- 20 41. The method of claim 35 wherein the hydraulic cement is at least one of portland cement, modified portland cement, masonry cement, or mixtures thereof.
42. The method of claim 35 further including pozzolan that is at least one of diatomaceous earth, opaline cherts, clays, shales, fly ash, silica fume, volcanic tuffs and pumicites, metakaolin, granulated blast furnace slag, fly ash, or mixtures 25 thereof.
43. The method of claim 35 further comprising a cement admixture or additive that is at least one of air detrainning agents, water reducers, wetting agents, water soluble polymers, strength enhancing agents, rheology modifying agents, water repellents, 30 dampproofing admixtures, gas formers, permeability reducers, pumping aids, fungicidal admixtures, germicidal admixtures, insecticidal admixtures, finely

divided mineral admixtures, alkali-reactivity reducer, bonding admixtures, shrinkage compensation agents, defoamers or aggregate.

44. The method of claim 43 wherein the shrinkage compensation agent is at least one of
5 RO(AO)₁₋₁₀H, wherein R is a C₁₋₅ alkyl or C₅₋₆ cycloalkyl radical and A is a C₂₋₃
alkylene radical, alkali metal sulfates, alkaline earth metal sulfates, or alkaline earth
oxides.
45. The method of claim 44 wherein the alkaline earth oxides are at least one of sodium
10 sulfate or calcium oxide.
46. The method of claim 43 wherein the defoamer is at least one of silicones or
petroleum oil mixtures.
- 15 47. The method of claim 35 wherein the water to cement ratio is about 0.2 to about
0.35.
48. The method of claim 35 wherein the cementitious materials content of the
cementitious member is about 800 lb/yd³ to about 1,600 lb/yd³.
20
49. The method of claim 35 wherein the structural synthetic fibers are at least one of
structural plastic fibers, carbon or mixtures thereof.
50. The method of claim 49 wherein the structural plastic fibers are at least one of
25 nylon, polyethylene, polyester, rayon, or mixtures thereof.
51. The method of claim 35 wherein the structural synthetic fibers have a diameter of
about 0.6 millimeters to about 1.2 millimeters.
- 30 52. The method of claim 35 wherein the structural synthetic fibers have a diameter of
about 0.8 millimeters to about 1.0 millimeters.

53. The method of claim 35 wherein the structural synthetic fibers have a length of about 15 millimeters to about 75 millimeters.
- 5 54. The method of claim 35 wherein the structural synthetic fibers have a modulus of about 3,000 N/mm² to about 4,000 N/mm².
55. The method of claim 35 wherein the structural synthetic fibers have a modulus of about 3,250 N/mm² to about 3,750 N/mm².
- 10 56. The method of claim 35 wherein the polycarboxylate high range water reducing dispersant has a solids content of about 20% to about 30% and is present in an amount from about 5 to about 35 oz/cwt.
57. The method of claim 35 wherein the primary active ingredient of the polycarboxylate high range water reducing dispersant is about 0.025% to about 15 0.7% based on dry weight of cement.
58. The method of claim 35 wherein the structural synthetic fiber loadings are about 1% to about 10% by volume of the composition.
- 20 59. The method of claim 35 wherein the member is at least one of wall panels, beams or columns.
60. The method of claim 35, wherein the polycarboxylate dispersant is at least one of 25 formulas a) through j):
- a) a dispersant of Formula (I):



wherein in Formula (I)

X is at least one of hydrogen, an alkali earth metal ion, an alkaline earth metal ion, ammonium ion, or amine;

5 R is at least one of C₁ to C₆ alkyl(ene) ether or mixtures thereof or C₁ to C₆ alkyl(ene) imine or mixtures thereof;

Q is at least one of oxygen, NH, or sulfur;

p is a number from 1 to about 300 resulting in at least one of a linear side chain or branched side chain;

10 R₁ is at least one of hydrogen, C₁ to C₂₀ hydrocarbon, or functionalized hydrocarbon containing at least one of -OH, -COOH, an ester or amide derivative of -COOH, sulfonic acid, an ester or amide derivative of sulfonic acid, amine, or epoxy;

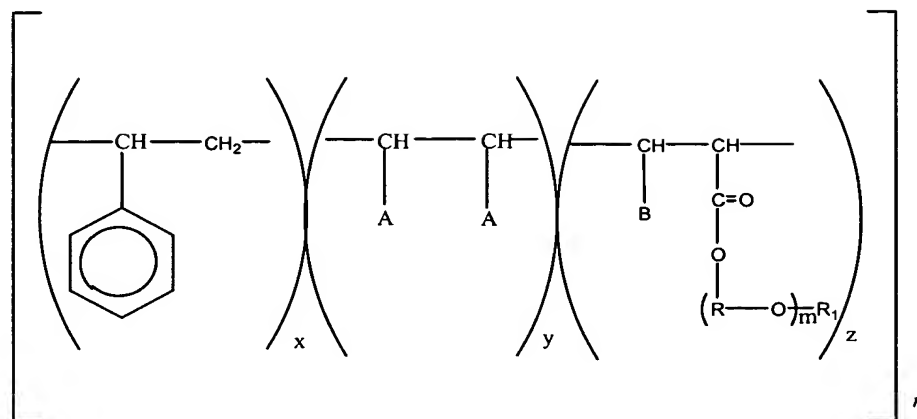
15 Y is at least one of hydrogen, an alkali earth metal ion, an alkaline earth metal ion, ammonium ion, amine, a hydrophobic hydrocarbon or polyalkylene oxide moiety that functions as a defoamer;

m, m', m'', n, n', and n'' are each independently 0 or an integer between 1 and about 20;

20 Z is a moiety containing at least one of i) at least one amine and one acid group, ii) two functional groups capable of incorporating into the backbone selected from the group consisting of dianhydrides, dialdehydes, and di-acid-chlorides, or iii) an imide residue; and

25 wherein a, b, c, and d reflect the mole fraction of each unit wherein the sum of a, b, c, and d equal one, wherein a, b, c, and d are each a value greater than or equal to zero and less than one, and at least two of a, b, c, and d are greater than zero;

b) a dispersant of Formula (II):



wherein in Formula (II):

A is COOM or optionally in the “y” structure an acid anhydride group (-CO-O-CO-) is formed in place of the A groups between the carbon atoms to which the A groups are bonded to form an anhydride;

B is COOM

M is hydrogen, a transition metal cation, the residue of a hydrophobic polyalkylene glycol or polysiloxane, an alkali metal ion, an alkaline earth metal ion, ferrous ion, aluminum ion, (alkanol)ammonium ion, or (alkyl)ammonium ion;

R is a C₂₋₆ alkylene radical;

R₁ is a C₁₋₂₀ alkyl, C₆₋₉ cycloalkyl, or phenyl group;

x, y, and z are a number from 0.01 to 100;

m is a number from 1 to 100; and

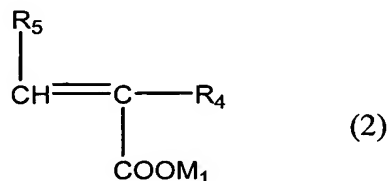
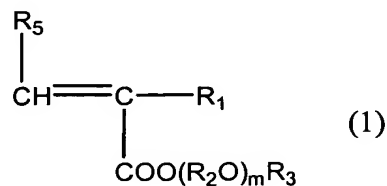
n is a number from 10 to 100;

c) a dispersant comprising at least one polymer or a salt thereof having the form of a copolymer of

i) a maleic anhydride half-ester with a compound of the formula RO(AO)_mH, wherein R is a C₁₋₂₀ alkyl group, A is a C₂₋₄ alkylene group, and m is an integer from 2-16; and

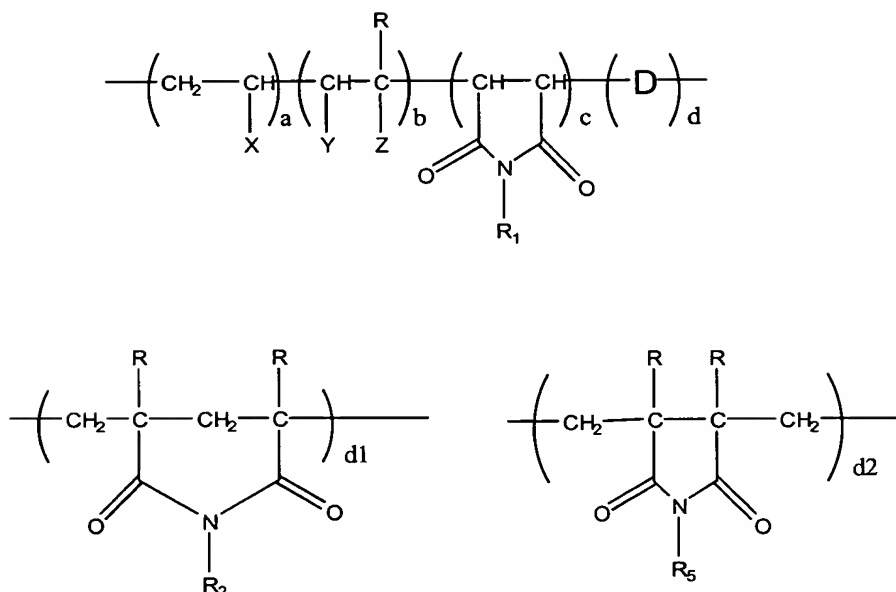
ii) a monomer having the formula CH₂=CHCH₂-(OA)_nOR, wherein n is an integer from 1-90 and R is a C₁₋₂₀ alkyl group;

- d) a dispersant obtained by copolymerizing 5 to 98% by weight of an (alkoxy)polyalkylene glycol mono(meth)acrylic ester monomer (a) represented by the following general formula (1):



- 5 wherein R_1 stands for hydrogen atom or a methyl group, R_2O for one species or a mixture of two or more species of oxyalkylene group of 2 to 4 carbon atoms, providing two or more species of the mixture may be added either in the form of a block or in a random form, R_3 for a hydrogen atom or an alkyl group of 1 to 5 carbon atoms, and m is a value indicating the average addition mol number of oxyalkylene groups that is an integer in the range of 1 to 100, 95 to 2% by weight of a (meth)acrylic acid monomer (b) represented by the above general formula (2), wherein R_4 and R_5 are each independently a hydrogen atom or a methyl group, and M_1 for a hydrogen atom, a monovalent metal atom, a divalent metal atom, an ammonium group, or an organic amine group, and 0 to 50% by weight of other monomer (c) copolymerizable with these monomers, provided that the total amount of (a), (b), and (c) is 100% by weight;
- 10 e) a graft polymer that is a polycarboxylic acid or a salt thereof, having side chains derived from at least one species selected from the group consisting of oligoalkyleneglycols, polyalcohols, polyoxyalkylene amines, and polyalkylene glycols;
- 15
- 20
- 25

f) a dispersant of Formula (III):



wherein in Formula (III):

D = a component selected from the group consisting of the structure d1, the structure d2, and mixtures thereof;

X = H, CH₃, C₂ to C₆ Alkyl, Phenyl, p-Methyl Phenyl, or Sulfonated Phenyl;

Y = H or -COOM;

R = H or CH₃;

Z = H, -SO₃M, -PO₃M, -COOM, -O(CH₂)_nOR₃ where n = 2 to 6, -COOR₃, or -(CH₂)_nOR₃ where n = 0 to 6, -CONHR₃, -CONHC(CH₃)₂CH₂SO₃M, -COO(CHR₄)_nOH where n = 2 to 6, or -O(CH₂)_nOR₄ wherein n = 2 to 6;

R₁, R₂, R₃, R₅ are each independently -(CHRCH₂O)_mR₄ random copolymer of oxyethylene units and oxypropylene units where m = 10 to 500 and wherein the amount of oxyethylene in the random copolymer is from about 60% to 100% and the amount of oxypropylene in the random copolymer is from 0% to about 40%;

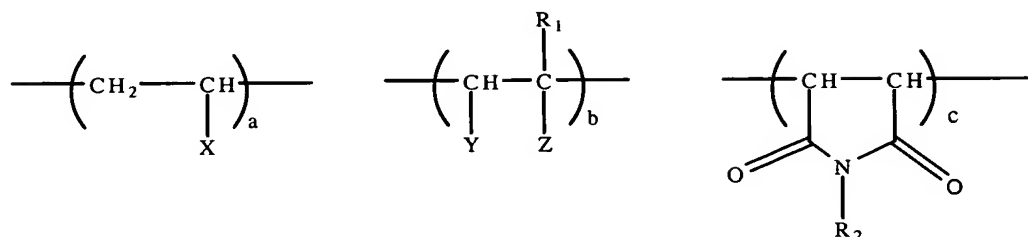
R₄ = H, Methyl, C₂ to about C₆ Alkyl, or about C₆ to about C₁₀ aryl;

M = H, Alkali Metal, Alkaline Earth Metal, Ammonium, Amine, triethanol amine, Methyl, or C₂ to about C₆ Alkyl;

- $a =$ 0 to about 0.8;
 $b =$ about 0.2 to about 1.0;
 $c =$ 0 to about 0.5;
 $d =$ 0 to about 0.5; and

5 wherein a, b, c, and d represent the mole fraction of each unit and the sum of a, b, c, and d is 1.0;

g) a dispersant of Formula (IV):



10 wherein in Formula (IV):

the "b" structure is one of a carboxylic acid monomer, an ethylenically unsaturated monomer, or maleic anhydride wherein an acid anhydride group (-CO-O-CO-) is formed in place of the groups Y and Z between the carbon atoms to which the groups Y and Z are bonded respectively, and the "b" structure must include at least one moiety with a pendant ester linkage and at

15 least one moiety with a pendant amide linkage;

$X =$ H, CH_3 , C_2 to C_6 Alkyl, Phenyl, p-Methyl Phenyl, p-Ethyl Phenyl, Carboxylated Phenyl, or Sulfonated Phenyl;

$Y =$ H, -COOM, -COOH, or W;

20 $W =$ a hydrophobic defoamer represented by the formula $\text{R}_5\text{O}-(\text{CH}_2\text{CH}_2\text{O})_s-(\text{CH}_2\text{C}(\text{CH}_3)\text{HO})_t-(\text{CH}_2\text{CH}_2\text{O})_u$ where s, t, and u are integers from 0 to 200 with the proviso that $t > (s+u)$ and wherein the total amount of hydrophobic defoamer is present in an amount less than about 10% by weight of the polycarboxylate dispersant;

25 $Z =$ H, -COOM, $-\text{O}(\text{CH}_2)_n\text{OR}_3$ where $n = 2$ to 6, $-\text{COOR}_3$, $-(\text{CH}_2)_n\text{OR}_3$ where $n = 0$ to 6, or $-\text{CONHR}_3$;

$\text{R}_1 =$ H, or CH_3 ;

R_2, R_3 , are each independently a random copolymer of oxyethylene units and oxypropylene units of the general formula $-(CH(R_1)CH_2O)_mR_4$ where $m=10$ to 500 and wherein the amount of oxyethylene in the random copolymer is from about 60% to 100% and the amount of oxypropylene in the random copolymer is from 0% to about 40%;

$R_4 =$ H, Methyl, or C_2 to C_8 Alkyl;

$R_5 =$ C_1 to C_{18} alkyl or C_6 to C_{18} alkyl aryl;

$M =$ Alkali Metal, Alkaline Earth Metal, Ammonia, Amine, monoethanol amine, diethanol amine, triethanol amine, morpholine, imidazole;

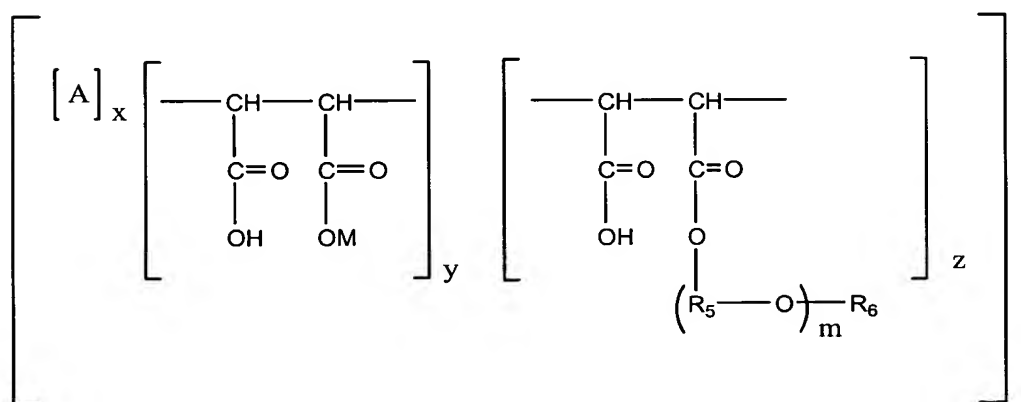
$a =$ 0.01-0.8;

$b =$ 0.2-0.99;

$c =$ 0-0.5; and

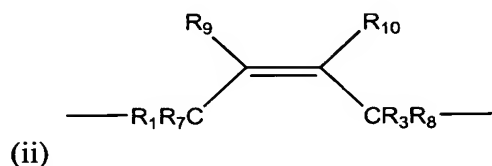
wherein a, b, c represent the mole fraction of each unit and the sum of a, b , and c , is 1;

h) a random copolymer corresponding to the following Formula (V) in free acid or salt form having the following monomer units and numbers of monomer units:



wherein A is selected from the moieties (i) or (ii)

(i) $-\text{CR}_1\text{R}_2-\text{CR}_3\text{R}_4-$



wherein R_1 and R_3 are selected from substituted benzene, C_{1-8} alkyl, C_{2-8} alkenyl, C_{2-8} alkylcarbonyl, C_{1-8} alkoxy, carboxyl, hydrogen, and a ring, R_2 and R_4 are selected from the group consisting of hydrogen and C_{1-4} alkyl, wherein R_1 and R_3 can together with R_2 and/or R_4 when R_2 and/or R_4 are C_{1-4} alkyl form the ring; ;

R_7 , R_8 , R_9 , and R_{10} are individually selected from the group consisting of hydrogen, C_{1-6} alkyl, and a C_{2-8} hydrocarbon chain, wherein R_1 and R_3 together with R_7 and/or R_8 , R_9 , and R_{10} form the C_{2-8} hydrocarbon chain joining the carbon atoms to which they are attached, the hydrocarbon chain optionally having at least one anionic group, wherein the at least one anionic group is optionally sulfonic;

M is selected from the group consisting of hydrogen, and the residue of a hydrophobic polyalkylene glycol or a polysiloxane, with the proviso that when A is (ii) and M is the residue of a hydrophobic polyalkylene glycol, M must be different from the group $-(R_5O)_mR_6$;

R_5 is a C_{2-8} alkylene radical;

R_6 is selected from the group consisting of C_{1-20} alkyl, C_{6-9} cycloalkyl and phenyl;

n , x , and z are numbers from 1 to 100;

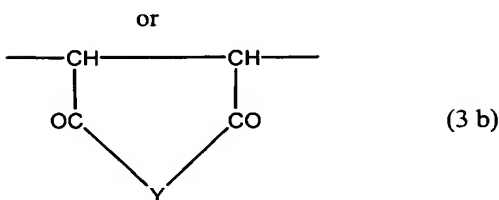
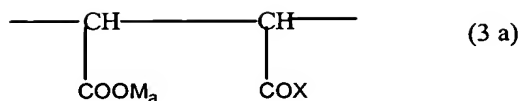
y is 0 to 100;

m is 2 to 1000;

the ratio of x to $(y+z)$ is from 1:10 to 10:1 and the ratio of $y:z$ is from 5:1 to 1:100;

i) a copolymer of oxyalkyleneglycol-alkenyl ethers and unsaturated dicarboxylic acids, comprising:

i) 0 to 90 mol % of at least one component of the formula 3a or 3b:



wherein M is a hydrogen atom, a mono- or divalent metal cation, an ammonium ion or an organic amine residue, a is 1, or when M is a divalent metal cation a is $\frac{1}{2}$;

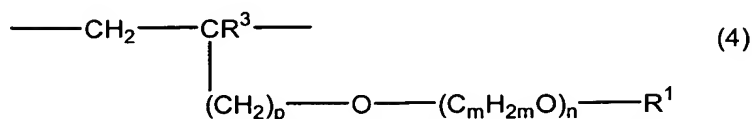
wherein X is $-\text{OM}_a$,

$-\text{O}-(\text{C}_m\text{H}_{2m}\text{O})_n-\text{R}^1$ in which R^1 is a hydrogen atom, an aliphatic hydrocarbon radical containing from 1 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an optionally hydroxyl, carboxyl, C_{1-14} alkyl, or sulphonic substituted aryl radical containing 6 to 14 carbon atoms, m is 2 to 4, and n is 0 to 100,

$-\text{NHR}_2$, $-\text{N}(\text{R}^2)_2$ or mixtures thereof in which $\text{R}^2=\text{R}^1$ or $-\text{CO}-\text{NH}_2$; and

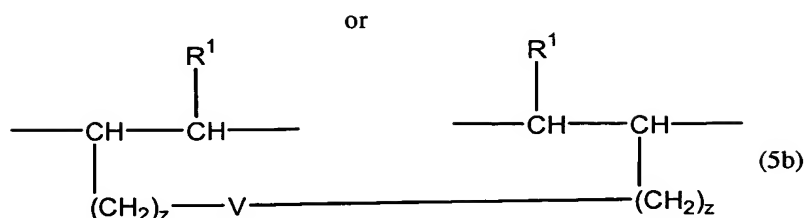
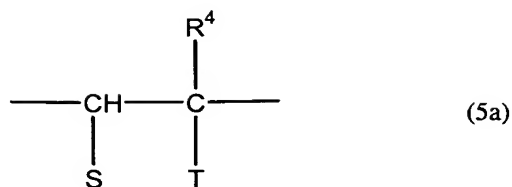
wherein Y is an oxygen atom or $-\text{NR}^2$;

ii) 1 to 89 mol% of components of the general formula 4:

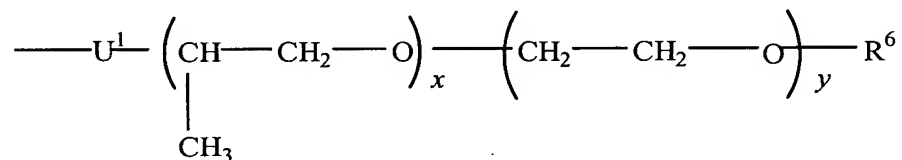


wherein R_3 is a hydrogen atom or an aliphatic hydrocarbon radical containing from 1 to 5 carbon atoms, p is 0 to 3, and R_1 is hydrogen, an aliphatic hydrocarbon radical containing from 1 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an optionally hydroxyl, carboxyl, C_{1-14} alkyl, or sulfonic substituted aryl radical containing 6 to 14 carbon atoms, m is 2 to 4, and n is 0 to 100, and

iii) 0.1 to 10 mol % of at least one component of the formula 5a or 5b:

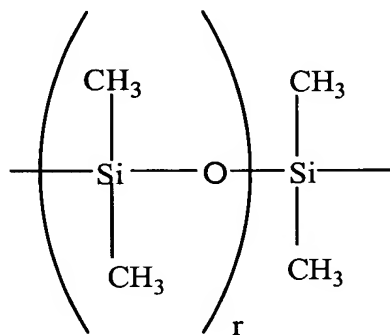


wherein S is a hydrogen atom or $-\text{COOM}_a$ or $-\text{COOR}_5$, T is $-\text{COOR}_5$, $-\text{W-R}_7$, $-\text{CO}[-\text{NH}-(\text{CH}_2)_3]_s-\text{W-R}_7$, $-\text{CO-O}-(\text{CH}_2)_z-\text{W-R}_7$, a radical of the general formula:



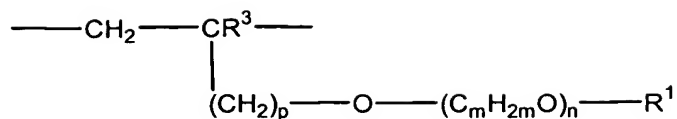
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or $-(\text{CH}_2)_z-\text{V}-(\text{CH}_2)_z-\text{CH}=\text{CH}-\text{R}_1$, or when S is $-\text{COOR}_5$ or $-\text{COOM}_a$, U_1 is $-\text{CO-NHM-}$, $-\text{O-}$ or $-\text{CH}_2\text{O}$, U_2 is $-\text{NH-CO-}$, $-\text{O-}$ or $-\text{OCH}_2$, V is $-\text{O-CO-C}_6\text{H}_4\text{-CO-O-}$ or $-\text{W-}$, and W is

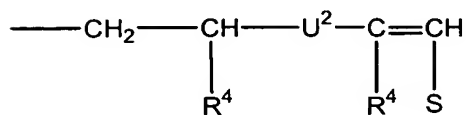
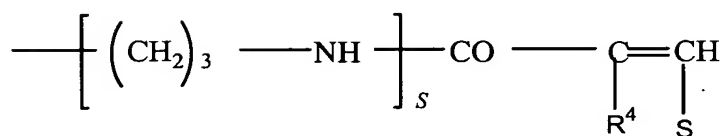


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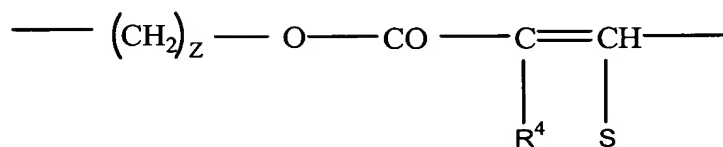
R_4 is a hydrogen atom or a methyl radical, R_5 is an aliphatic hydrocarbon radical containing 3 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an aryl radical containing 6 to 14 carbon atoms, $\text{R}_6=\text{R}_1$ or



or

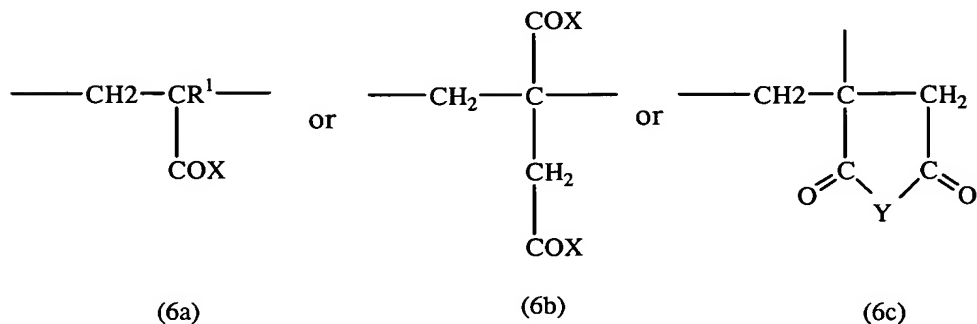
 $\text{R}_7 = \text{R}_1$ or

or

 r is 2 to 100, s is 1 or 2, x is 1 to 150, y is 0 to 15 and z is 0 to 4;

5

iv) 0 to 90 mol % of at least one component of the formula 6a, 6b, or 6c:



wherein M is a hydrogen atom, a mono- or divalent metal cation, an ammonium ion or an organic amine residue, a is 1, or when M is a divalent metal cation a is $\frac{1}{2}$;

wherein X is $-\text{OM}_a$,

10

$-\text{O}-(\text{C}_m\text{H}_{2m}\text{O})_n-\text{R}^1$ in which R^1 is a hydrogen atom, an aliphatic hydrocarbon radical containing from 1 to 20 carbon atoms, a cycloaliphatic hydrocarbon radical containing 5 to 8 carbon atoms or an optionally hydroxyl, carboxyl, C_{1-14} alkyl, or sulphonic substituted aryl radical containing 6 to 14 carbon atoms, m is 2 to 4, and n is 0 to 100,

$-\text{NH}-(\text{C}_m\text{H}_{2m}\text{O})_n-\text{R}^1$,

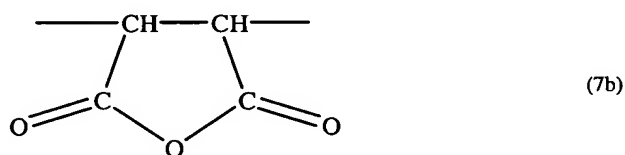
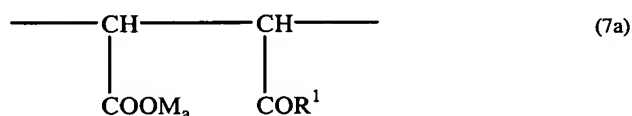
$-\text{NHR}_2, -\text{N}(\text{R}^2)_2$ or mixtures thereof in which $\text{R}^2 = \text{R}^1$ or

$-\text{CO}-\text{NH}_2$; and

wherein Y is an oxygen atom or $-\text{NR}^2$;

j) a copolymer of dicarboxylic acid derivatives and oxyalkylene glycol-alkenyl ethers, comprising:

i) 1 to 90 mol.% of at least one member selected from the group consisting of structural units of formula 7a and formula 7b:



wherein M is H , a monovalent metal cation, a divalent metal cation, an ammonium ion or an organic amine;

a is $\frac{1}{2}$ when M is a divalent metal cation or 1 when M is a monovalent metal cation;

wherein R^1 is $-\text{OM}_a$, or

$-\text{O}-(\text{C}_m\text{H}_{2m}\text{O})_n-\text{R}^2$ wherein R^2 is H , a C_{1-20} aliphatic hydrocarbon, a C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one member selected

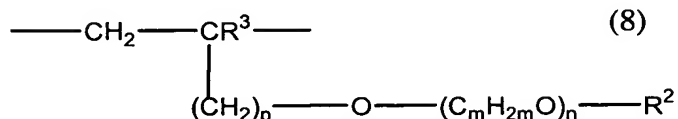
from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}]$;

m is 2 to 4;

n is 1 to 200;

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ii) 0.5 to 80 mol. % of the structural units of formula 8:



wherein R^3 is H or a C_{1-5} aliphatic hydrocarbon;

p is 0 to 3;

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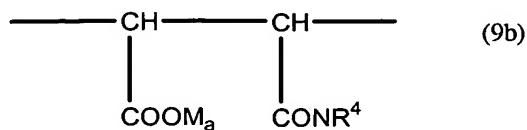
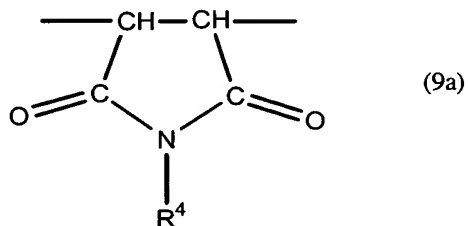
R^2 is H, a C_{1-20} aliphatic hydrocarbon, a C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one member selected from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}]$;

m is 2 to 4;

n is 1 to 200;

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iii) 0.5 to 80 mol. % structural units selected from the group consisting of formula 9a and formula 9b:



wherein R^4 is H, C_{1-20} aliphatic hydrocarbon that is optionally substituted with at least one hydroxyl group, $-(\text{C}_m\text{H}_{2m}\text{O)}_n\text{---R}^2$, $-\text{CO-NH-R}^2$, C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one

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member selected from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}]$;

M is H, a monovalent metal cation, a divalent metal cation, an ammonium ion or an organic amine;

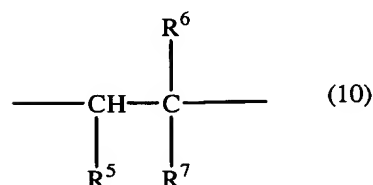
5 a is $\frac{1}{2}$ when M is a divalent metal cation or 1 when M is a monovalent metal cation;

R^2 is H, a C_{1-20} aliphatic hydrocarbon, a C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl that is optionally substituted with at least one member selected from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}]$;

10 m is 2 to 4;

n is 1 to 200;

iv) 1 to 90 mol. % of structural units of formula 10



15 wherein R^5 is methyl, or methylene group, wherein R^5 forms one or more 5 to 8 membered rings with R^7 ;

R^6 is H, methyl, or ethyl;

R^7 is H, a C_{1-20} aliphatic hydrocarbon, a C_{6-14} aryl that is optionally substituted with at least one member selected from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, and $-(\text{PO}_3)\text{M}_{a2}]$, a C_{5-8} cycloaliphatic hydrocarbon, $-\text{OCOR}^4$, $-\text{OR}^4$, or $-\text{COOR}^4$,
20 wherein R^4 is H, a C_{1-20} aliphatic hydrocarbon that is optionally substituted with at least one $-\text{OH}$, $-(\text{C}_m\text{H}_{2m}\text{O})_n\text{R}^2$, $-\text{CO}-\text{NH}-\text{R}^2$, C_{5-8} cycloaliphatic hydrocarbon, or a C_{6-14} aryl residue that is optionally substituted with a member selected from the group consisting of $[-\text{COOM}_a$, $-(\text{SO}_3)\text{M}_a$, $-(\text{PO}_3)\text{M}_{a2}]$.

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61. The method of claim 60, wherein said forming is one of i) placing said unset high early-strength reinforced cementitious composition in a mold and vibrating said mold, ii) allowing the high early-strength reinforced cementitious composition to cure or set into an article, and iii) stripping the cured or set article from said mold.

62. The method of claim 60 wherein a set accelerator is present.

63. The method of claim 62, wherein the set accelerator comprises at least one of:

- a) a nitrate salt of an alkali metal, alkaline earth metal, or aluminum;
- b) a nitrite salt of an alkali metal, alkaline earth metal, or aluminum;
- c) a thiocyanate of an alkali metal, alkaline earth metal or aluminum;
- d) an alkanolamine;
- e) a thiosulfate of an alkali metal, alkaline earth metal, or aluminum;
- f) a carboxylic acid salt of an alkali metal, alkaline earth metal, or aluminum;
- or
- g) a polyhydroxylalkylamine.

64. The method of claim 60 wherein a set retarder is present.

65. The method of claim 64 wherein the set retarder is at least one of an oxy-boron compound, lignin, a polyphosphonic acid, a carboxylic acid, a hydroxycarboxylic acid, polycarboxylic acid, hydroxylated carboxylic acid, fumaric, itaconic, malonic, borax, gluconic, and tartaric acid, lignosulfonates, ascorbic acid, isoascorbic acid, sulphonic acid-acrylic acid copolymer, and their corresponding salts, polyhydroxysilane, polyacrylamide, carbohydrates or mixtures thereof.

66. The method of claim 60 wherein the hydraulic cement is at least one of portland cement, modified portland cement, masonry cement, or mixtures thereof.

67. The method of claim 60 further including pozzolan that is at least one of diatomaceous earth, opaline cherts, clays, shales, fly ash, silica fume, volcanic tuffs and pumicites, metakaolin, granulated blast furnace slag, fly ash, or mixtures thereof.

68. The method of claim 60 further comprising a cement admixture or additive that is at least one of air detrainning agents, water reducers, wetting agents, water soluble polymers, strength enhancing agents, rheology modifying agents, water repellents,

dampproofing admixtures, gas formers, permeability reducers, pumping aids, fungicidal admixtures, germicidal admixtures, insecticidal admixtures, finely divided mineral admixtures, alkali-reactivity reducer, bonding admixtures, shrinkage compensation agents, defoamers or aggregate.

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69. The method of claim 68 wherein the shrinkage compensation agent is at least one of $\text{RO(AO)}_{1-10}\text{H}$, wherein R is a C_{1-5} alkyl or C_{5-6} cycloalkyl radical and A is a C_{2-3} alkylene radical, alkali metal sulfates, alkaline earth metal sulfates, or alkaline earth oxides.

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70. The method of claim 69 wherein the alkaline earth oxides are at least one of sodium sulfate or calcium oxide.

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71. The method of claim 68 wherein the defoamer is at least one of silicones or petroleum oil mixtures.

72. The method of claim 60 wherein the water to cement ratio is about 0.2 to about 0.35.

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73. The method of claim 60 wherein the cementitious materials content of the cementitious member is about 800 lb/yd^3 to about $1,600 \text{ lb/yd}^3$.

74. The method of claim 60 wherein the structural synthetic fibers are at least one of structural plastic fibers, carbon or mixtures thereof.

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75. The method of claim 74 wherein the structural plastic fibers are at least one of nylon, polyethylene, polyester, rayon, or mixtures thereof.

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76. The method of claim 60 wherein the structural synthetic fibers have a diameter of about 0.6 millimeters to about 1.2 millimeters.

77. The method of claim 60 wherein the structural synthetic fibers have a diameter of about 0.8 millimeters to about 1.0 millimeters.
- 5 78. The method of claim 60 wherein the structural synthetic fibers have a length of about 15 millimeters to about 75 millimeters.
79. The method of claim 60 wherein the structural synthetic fibers have a modulus of about 3,000 N/mm² to about 4,000 N/mm².
- 10 80. The method of claim 60 wherein the structural synthetic fibers have a modulus of about 3,250 N/mm² to about 3,750 N/mm².
81. The method of claim 60 wherein the polycarboxylate high range water reducing dispersant has a solids content of about 20% to about 30% and is present in an amount from about 5 to about 35 oz/cwt.
- 15 82. The method of claim 60 wherein the primary active ingredient of the polycarboxylate high range water reducing dispersant is about 0.025% to about 0.7% based on dry weight of cement.
- 20 83. The method of claim 60 wherein the structural synthetic fiber loadings are about 1% to about 10% by volume of the composition.
84. The method of claim 60 wherein the member is at least one of wall panels, beams or columns.